CHAPTER ELEVEN

TRANSITION FROM DEVELOPMENT TO PRODUCTION

CONTENTS

TRANSITION FROM DEVELOPMENT TO PRODUCTION

OBJECTIVE

The challenge of program management is to find the practical middle ground between producing underdeveloped systems and extended development and testing to the nth degree of a few high cost systems that never reach rate production. Key guidelines to follow are:

1. Select an acquisition strategy and risk management plan in context with the unique aspects of the program.

2. Avoid planning a development to production gap into the program.

3. Enter full-scale development only with a solid technology base and a management commitment for timely support and continuity of effort, provided that the need still exists and satisfactory progress is maintained.

4. Plan for transition to production starting at program initiation.

INTRODUCTION

This chapter discusses some of the organizational and functional issues which are involved in the transition from development to production and the process for evaluation and management. The changes in organizational focus and activity are presented along with a discussion of the impact of gaps between development and production. The relationships among engineering design release, initial production facilities and producibility engineering and planning (PEP) are discussed as they impact the transition process.

Management of a major weapon system from development through production requires effective administration and coordination of many activities. At the production phase, large financial commitments are made based on the detailed planning of previous phases. The transition is a highly visible, highly reactive time that is characterized by emphasis on preparation for production and change management. A program manager should recognize the fundamental principle that systems acquisition is an industrial process which demands both an understanding of that process and the implementation of basic engineering disciplines and their control mechanisms. The Defense Science Board (DSB) Task Force on Transitioning from Development to Production, in their May 1983 report "Solving the Risk Equation in Transitioning from Development to Production," provided abundant evidence that transition from full scale development into production places particular demands on engineering design, test, and manufacturing, in both application and timing, and emphasizes assurance of design stability and certification of the manufacturing process. The Board determined that the problems with the acquisition process were not administrative, but instead were technical. They further determined that this technical process focused on three critical activities: design, test and production.

TRANSITION PROCESS OVERVIEW

Transition from development to production is not an event with a readily identifiable starting point in the acquisition process. The transition process incorporates many activities shown in Figure 11-1. It is a continuum of interrelated and interdependent activities. Military acquisition has time and time again extended the product development effort well into the production phase. As a consequence, numerous product changes are introduced, planning essential for manufacturing is delayed, and the burden on manufacturing to "make up time" for engineering delays is a monumental task for what could otherwise be a successful acquisition program. "Fast tracking" is a high risk venture. The transition process is very broad and it is impacted by activities that are or, more accurately, are not done in the early design and test activities.

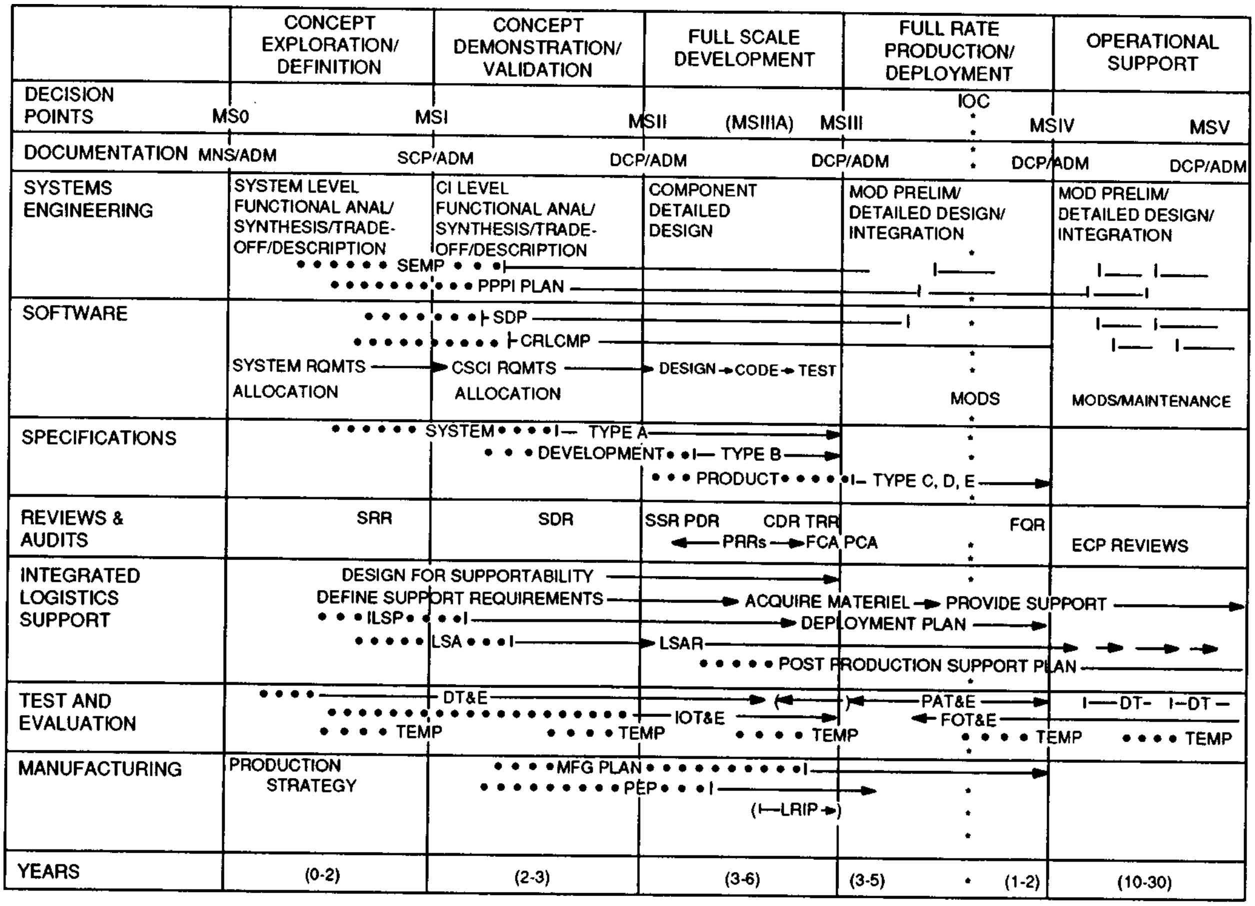


Figure 11-1 Acquisition Process for Major Weapon Systems

Planning for production and manufacturing engineering, following the design process, is a major transition risk. Documented early producibility engineering and planning integrated with advanced development offers benefits of increased end-item compatibility with the process and procedures necessary to produce the item, and reduces the number of changes in the product configuration introduced on the factory floor. Acquisition costs and schedule delays will be reduced when the program is structured to accommodate the transition to production.

Documented early planning focusing on the specifics of the manufacturing practices and processes required to build the end item should be initiated while the design is fluid, and completed before the start of rate production. A manufacturing plan should be a comprehensive document, provide guidelines for action, identify and give visibility to high risk factors, and then provide direction by which risk can be minimized. The report cited earlier, "Solving the Risk Equation in Transitioning from Development to Production," lists the essential elements of a manufacturing plan which will significantly reduce the risk of transitioning a program from development to production.

- Master delivery schedule which identifies by each major subassembly the time spans, need dates, and who is responsible
- Hard tooling requirements to meet increased production rates as the program progresses
- Special tools

- Special test equipment
- Assembly flow charts
- inspection requirements and yield thresholds
- Production yield thresholds
- Producibility studies
- Design improvements
- Production control
- Critical processes
- Cost/schedule reports
- Trend reports
- Product assurance
- Fabrication plan
- Engineering release plan

Further, items that represent new processes may also be considered when generating a manufacturing plan. They are usually driven by unique aspects of the acquisition, capabilities of the contractor, or initiatives of the military procurement agency.

The transition process is a very broad one and it is very dependent upon certain activities to take place in order for the program to have a smooth, orderly progression. The activities that must take place during the transition of a weapon system's program are specified by the templates shown in Figure 11-2. The templates can be thought of as wickets to pass through before the major template function may be achieved. For example, the major template of Design has fourteen supportive templates, each of which must be addressed in a disciplined manner before the design template can achieve design maturity and thus fulfill the requirements for transition from R&D to production.

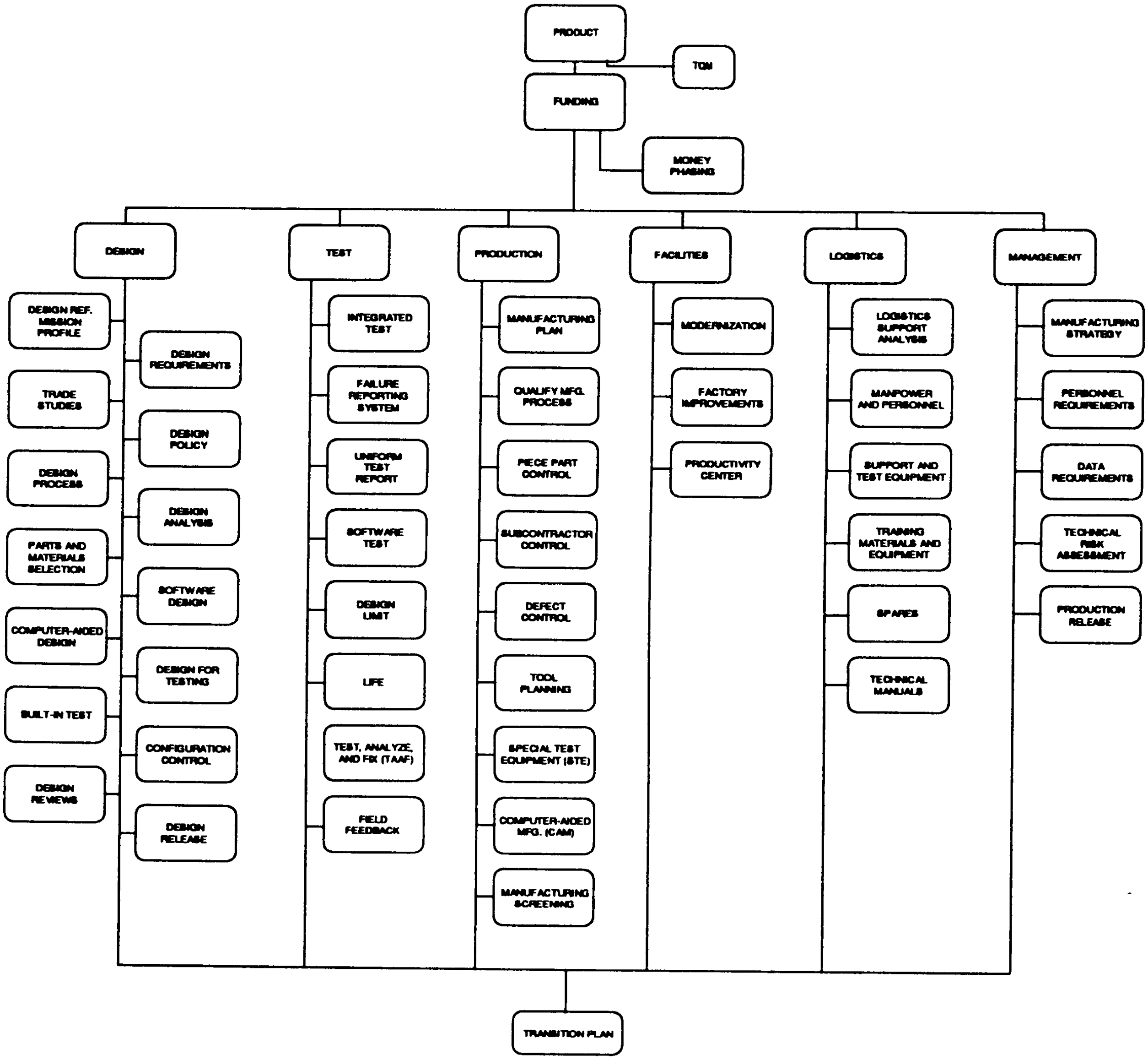
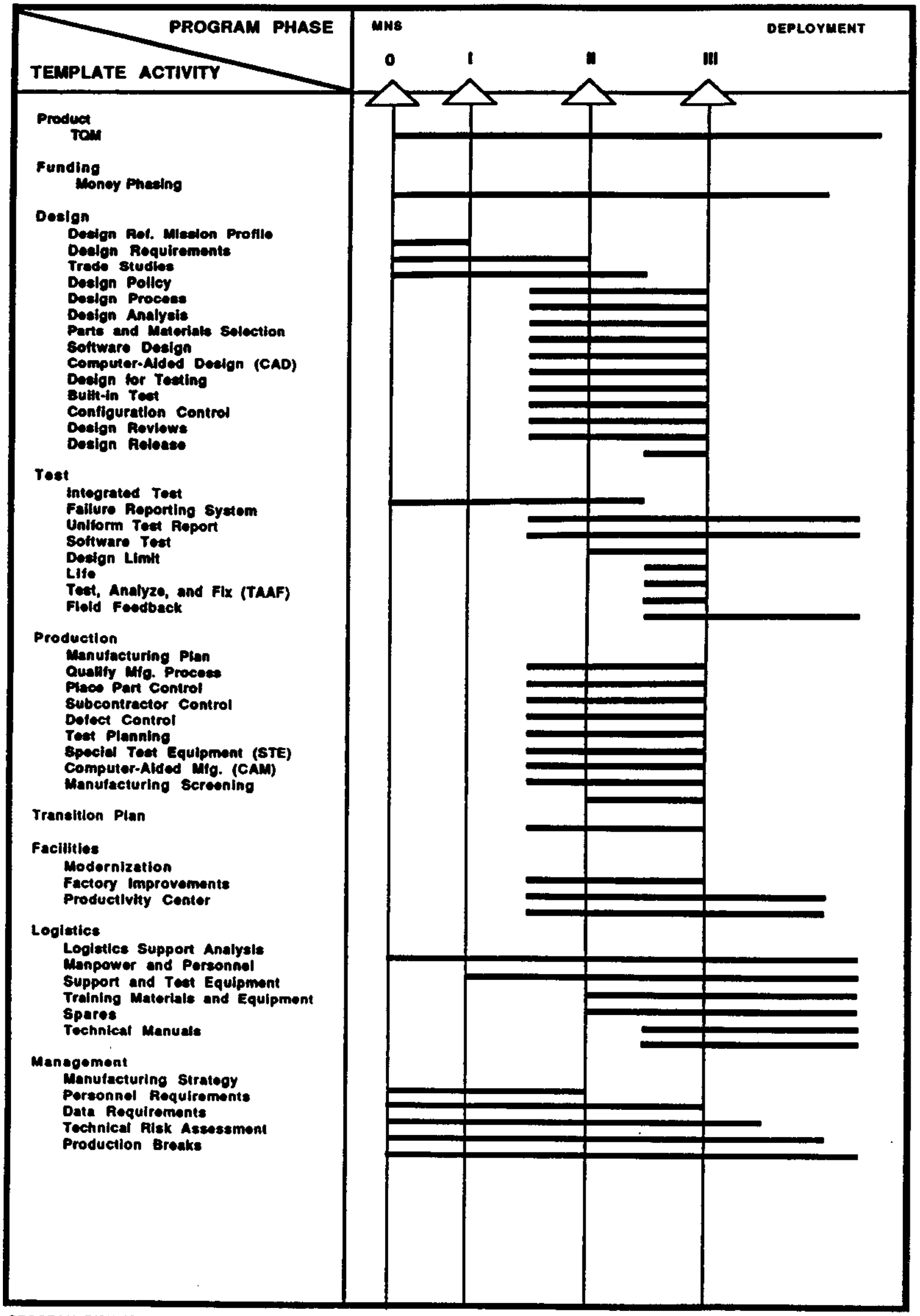


Figure 11-2 Critical Path Templates

In the Introduction, we stated that the DSB task force identified design, test, and production as the most critical functions of the industrial process, and thus they were identified as the original templates. Since that time the DOD conducted an industry - wide review and additional templates have been identified. These additional templates of funding, facilities, logistics, management and transition plan have joined the original three as shown in Figure 11-3. They are arranged in what would be considered a logical sequence from a program manager's viewpoint. For example, the Funding templates is shown in a position that influences each of the other templates and the transition plan template is shown in a position of depending upon other, preceding templates.



PROGRAM RISK IS INTRODUCED WHEN A PARTICULAR TEMPLATE ACTIVITY IS STARTED LATE OR CONTINUES BEYOND THE TIMELINE

Figure 11-3 Template Timelines

By showing the template activities as a timeline chart in 11-3 one can see that the template activities - which comprise an orderly transition process - are interrelated and interdependent. The chart shows the activities of the templates and their starting times in relation to other template activities. For example, one can see that the production template activities are started after the initial activities of the Design template, but in conjunction with the design templates with would affect producibility, i.e., the activities of tool planning, and qualification of the manufacturing process happen in conjunction - and coordination - with those of design analysis, and parts and material selection.

This chart also shows that design and production template activities have concluded by Milestone III A, which is the start of low rate initial production (LRIP). The chart indicates a stable, mature, design release, accompanied by manufacturing processes that have qualified for production, which illustrates a smooth transition from design to production. The chart also shows the desired relationships of some templates whose activities continue into the deployment phase, such as field feedback (Design) and logistics support analysis (Logistics).

DOD Directive 4245.7M “Transition from Development to Production” consolidates established policy, prescribes procedures, and assigns responsibilities on the application of fundamental engineering and technical disciplines in acquisition programs to expedite the transition from development to production. It requires a rigorous, disciplined application of fundamental engineering principles, methods and techniques, and the identification and assessment of elements of program risk throughout the acquisition cycle.

Additional guidance on the transition process is contained in DOD 4245.7M “Transition from Development to Production.” It provides assistance to program managers in structuring technically sound programs, assessing risk, and identifying areas needing corrective action. DOD 4245.7M identifies and addresses the “templates” designed to introduce discipline into the acquisition process, to identify and give visibility to high risk factors, and then to provide the tools by which risk can be minimized progressively.

So the program continues, the templates are applied, and the contractor’s progress is evaluated in relation to milestone achievement through Production Readiness Review (PRR) described above. The PRR team structures the review according to the templates of DOD 4245.7M. Figure 11-4 shows the topics by which a PRR is structured, and the applicable template for that topic.

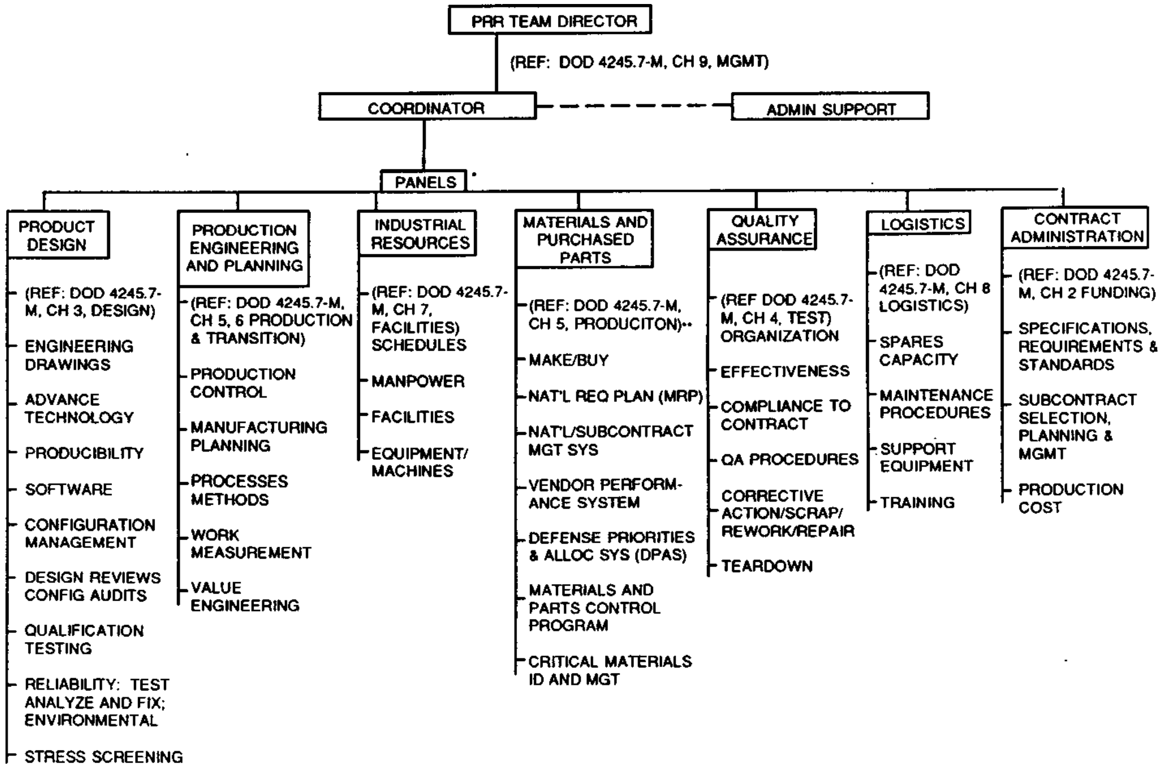


Figure 11-4 PRR Template Relationship

MAJOR CHALLENGES IN TRANSITION

The challenge of program management is construction and implementation of a program acquisition strategy that by a series of disciplined events and planning, results in the scheduled delivery, performance, and required quality of the end item. The disciplined series of events comprises the transition of a program from design to production. A program manager should recognize that system acquisition demands an understanding of the transition process and its control mechanisms. The transition process is very board and it is impacted by the activities that occur, or fail to occur, from the early design phase of a program to the production phase. The control mechanisms, or disciplines, of the transition process are called templates. The attainment of, and compliance with the templates results in a disciplined transition process. DOD 4245.7M “Transition From Development to Production”, states that transition is not a discrete event in time, but rather a process composed of three elements: design, test, and production. These three are joined by four other key elements - funding, facilities, logistics, and management - to comprise seven critical path templates which, along with their respective risk assessment templates, comprise a disciplined transition process applicable to any program.

There are certain factors and events that present challenges to the implementation and success of the transition process. In some cases these challenges are addressed directly by the transition templates; in others they are not. This chapter addresses some of those challenges.

Producibility

Producibility, in the manufacturing process, is the compatible result of an interdependent relationship involving the elements of Design, Test, and Production. Not everything that a designer puts on paper is producible. To qualify as producible a design must be such that it can be produced and tested by practical, cost-effective processes.

Producibility engineering and planning is an integral element of the design process. In order to achieve this, close coordination and communication between production, and design engineering must be established early in the design process. To simplify, production engineering should be looking over the shoulder of the design engineer as the design is being defined and stabilized, in order to provide input regarding material selection, design producibility and other manufacturing related issues. If the design is so intricate and detailed that it cannot be made by other than expensive model-shop process when the requirements are for large, production-line quantities, it is the responsibility of the production engineer to work closely with the design engineer to attain a more producible design. The Design, Test, and Production templates include the fundamental elements by which producibility can be attained when addressed in disciplined manner, as stated in DOD 4245.7M.

Design Maturity

A design is not mature unless it can be produced, tested, function to requirements, and be supported properly in the field. Before these requirements can be met, the necessary communication must take place during the design phase between the functional elements of design engineering, test engineering, production, logistics, and procurement.

In order to achieve design maturity, producibility and testability must be designed - into the product. If a design is so complicated that it cannot be tested, then there is also an excellent chance that it cannot be manufactured; if the design cannot be manufactured, then it is not a mature design.

Design maturity is almost synonymous with producibility. As the design matures, it reaches a higher level of producibility. An indication of design maturity is a lack of, or decline, in the number of formal engineering change notices (ECN) being processed. This indicates that producibility and testability problems are becoming fewer.

Many of the same Design, Test, and Production templates that are used to attain program producibility are also used to achieve design maturity because of the interdependency of the two functions.

Quality Assurance Planning and Defect Prevention

Quality Assurance (QA) Planning and Defect Prevention is another subject that is very interdependent with other program conditions, such as producibility and design maturity. The more producible the program, the higher the level of program QA and the higher the resulting quality.

Another significant template is introduced with this subject; the Failure Reporting System (Test) template. The implementation of the Failure Reporting and Corrective Action System (FRACAS) is critical to the Failure Reporting System template. The template informs us of the need or requirement to have a failure reporting system, and FRACAS describes that system.

A failure reporting system is necessary for the timely dissemination of accurate failure information in order that remedial actions may be taken promptly to prevent the recurrence of the failure. By the implementation of FRACAS those requirements can be met. FRACAS is a closed-loop system that initiates failure reports, analyzes the failures, and provides corrective actions for those failures back into the design, manufacturing, and test processes in order to prevent that same type of failure from happening again.

QA planning and defect prevention however, is an extremely wide requirement and is present throughout the transition template structure, as well as being a central tenet of DOD Total Quality Management. Without an effective QA planning and defect prevention program the cost of rework and repair would be excessive; the "hidden factory" would become larger and larger. Consequently, for a QA and defect prevention program to be effective, it cannot be localized to just one or two templates, but it must extend to all concerned areas, or in this case, templates. Those "concerned areas" are the three primary manufacturing risk areas of Design, Test, and

Production, and each of these templates is supported by templates that share an ultimate goal to improve quality, and prevent defects.

With the disciplined implementation of the transition templates the subject of Total Quality Management and defect prevention becomes more than a milestone, it becomes a manufacturing “atmosphere.”

Production Cost Analysis

The impact upon production cost as the result of the use of the templates for a successful transition from R&D Design to Production, is that production costs are ultimately lower. As the template principles and guidelines are applied to a program in a disciplined manner, efficiency is increased and errors are reduced or eliminated, thereby greatly reducing the costs incurred by the “hidden factory” while performing rework and/or repair. The templates address risks and situations that are technical, and not administrative which have significant impact on production cost.

Production Planning

A successful, thorough production planning activity must be in place in order for a program to successfully transition from development to production. Production planning is an element that comprises activities that are critical to a disciplined program and its transition to production. These activities, along with the templates to which the relate, are shown in Figure 11-5.

Activity	Template
Policies and Procedures	Management Strategy Qualify Manufacturing Process
Master Phasing Schedule	Manufacturing Plan
Manufacturing Lead Times	Manufacturing Plan
Critical Component Identification/ Control	Manufacturing Plan
Production Schedule/Control	Qualify Manufacturing Process Manufacturing Plan
Bottlenecks & Work-Arounds	Manufacturing Plan
Manufacturing Job Sheet	Qualify Manufacturing Process
Design Release Risk Analysis	Qualify Manufacturing Process
Machine/Plant/Loading Capacity	Manufacturing Plan
Make or Buy Plan	Manufacturing Plan

Figure 11-5 Production Planning - Template Relationship

The production planning is usually based on documented procedures that maintain consistency in planning from one project to the other. Although there are other critical elements comprising production planning, one of the most critical is the Master Phasing Schedule. This is used during the initial production planning and depicts a logical time - phasing of program milestones established in order to comply with the program schedule from contract initiation to product delivery. The Master Phasing Schedule serves as a basis for establishment of the Manufacturing Plan.

Another example of inter-dependency between Production Planning and the templates is that the manufacturing job sheets, which are an integral part of production planning, cannot be prepared until after the template activities of Design Release, and Qualify Manufacturing Process have taken place.

Planning for resource availability must take place during the very early phases of a program; and the transition templates of Facilities, and Management assist the PM to accomplish this. The Facilities template is supported by three templates: Modernization, Factory Improvements, and Producibility Center, all of which impact Resource Availability. The Personnel Requirements template supporting the Management template helps the PM plan to ensure personnel availability when it will be needed. In summary, the templates to assist the PM to plan for resource availability are available.

Production Design Change Introduction

Introduction of a design change after the production phase of a program has started is always a cause for concern and caution. This is something that should be avoided if at all possible. When a design change is introduced after production has started, any chance for a smooth transition from Development to Production that may have existed is significantly reduced, if not eliminated.

A Production Readiness Review (PRR) is conducted prior to the approval for the contractor to start the production phase of the program. At that time, the status of the program design is evaluated. If the design is to be mature, it must be considered qualified and ready for production; if the design is not considered to be mature, the program should not be allowed to go into the production phase. Theoretically, it is reasonable to assume that if a design change is introduced after production has started, the design was not really mature at the time of the PRR. By the time that a program starts production, the manufacturing process has been qualified and tooling built. Consequently, any design change introduced after the start of production could require changes in process, new tooling, personnel retraining and a number of other impacts, all of which can be very costly, both from a financial and a schedule standpoint.

So how do we avoid this undesirable activity? We avoid it by using the two templates of Design Release, and Qualify Manufacturing Process. These templates provide the Program Manager (PM) with tools by which to avoid an undesirable production design change introduction. The templates, when used in conjunction with each other, can do much toward the assurance of a smooth transition from Development to Production.

PRODUCIBILITY ENGINEERING AND PLANNING (PEP)

Initial production uncertainties need to be analyzed and contingencies addressed to avoid or minimize program disruptions and associated cost overruns as a weapon system progresses from Development to Production. The purpose of PEP is to insure that product designs reflect good producibility considerations prior to release for manufacturing. As in R&D, risks are inherent in the system during early production. PEP begins with those activities and events occurring perhaps three or four years before Milestone III and extends to the state of routine production. Although there is no commonly accepted starting point for PEP, it is prudent to anticipate production system requirements as early in the program as in the concept demonstration/validation phase, when only a small percentage of the total expected program life cycle costs has been incurred.

PEP involves the engineering tasks necessary to ensure timely, efficient and economic production of essential material and is primarily “software” in nature. It includes efforts related to development of the Technical Data Package (TDP), Quality Assurance (QA) procedures, and evaluation of special production processes through trade studies. Also included are development of unique processes essential to the design and manufacture of the material and details of performance ratings; dimension and tolerance data; manufacturing methods; sequences; assembly; schematics; physical characteristics including form, fit and function; inspection test and evaluation requirements; calibration information and quality control procedures.

PEP is, in effect, a qualification process that will confirm the adequacy of the production planning, tool design, manufacturing process, and procedures before rate production begins.

It is DOD policy that factors affecting producibility and supportability shall be fully integrated during full scale development. The design and test cycle shall be structured to provide a continuum in development for production, as opposed to discrete phases that cause iterative and redundant activities. The PEP program should be defined contractually and contain specific tasks and measurable performance that will support an orderly transition. PEP progress should be tracked by means of production readiness reviews required before initial or full production decisions. The objective of a transition plan is to provide visibility of how well each activity is being executed. To be effective, progress should be regularly compared against the transition plan.

Integrate Initial Production Facilities with Producibility Engineering and Planning

Only minimum manufacturing tools are required in the development phase to build and assemble prototype or test articles to be used for testing and evaluation of the engineering design. Off-the-shelf tools are utilized as much as possible and often prototype articles are, for all practical purposes, hand assembled. At some point in the development phase, consideration must be given to production tooling requirements. The Initial Production Facilities (IPF) effort is performed during the initiation of the Production Phase and provides the special tooling and test equipment needed to enter the production phase. The design and supporting documents for special tooling and test equipment are provided under Producibility Engineering & Planning. IPF translates these designs into a functioning production facility. Specific tasks include:

- Fabrication and validation of special manufacturing equipment.
- Fabrication and validation of Special Acceptance and Inspection Equipment (SAIE) and other special inspection equipment and gages.
- Initial set-up of the manufacturing line, if appropriate.
- Maintenance of special equipment.

Integrate Long Lead Items with Producibility Engineering and Planning

Manufacturing documentation is prepared as a part of the PEP effort, and includes the master tooling plan, the manufacturing line layout and identification of long lead time items. Product design specifications should be relatively mature, at least with regard to special or scarce material requirement, major production equipment and special purpose production tooling which has to be ordered well in advance of start-up time. The early stages of development characteristically produce many Engineering Change Proposals (ECPs) and the PM must ascertain that the contractor is doing the necessary planning for manufacturing with special consideration for the long lead items.

DEVELOPMENT/PRODUCTION GAPS

Previous acquisition policies have been such that a gap can be created between phases in the acquisition cycle. The gap is most pronounced between the development activity and the production of the system for inventory. One need only to examine some of the past directives to understand the reasons that such a gap is inherent in our systems acquisition cycle. The Deputy Secretary of Defense, David Packard, in a 31 July 1969 memo to the Service Secretaries stated, “There is a general deficiency in the amount of test and evaluation before we commit significant resources to production. While it is generally a mistake to schedule a complete break between development and production, we have tended to drift too far in the direction of concurrency, and this must be reversed.” A Blue Ribbon Defense Panel reported in July 1970, “guard against concurrent development and production.... Defer production decision until successful demonstration of developmental prototypes.” A GAO Report in March 1973, “Cost Growth in Major Weapon Systems,” had the following recommendations: “Avoid concurrent development and production.... Adhere to orderly and sequential design, test, and evaluation,” and, . . . clear separation of development and production.” DOD Directives 5000.1 and 5000.2 clearly state that the production phase will not be initiated until all engineering is reasonably complete and all significant design problems have been identified with solutions in hand. These directives further specify that Initial Operational Test & Evaluation (IOT&E) will be accomplished prior to the first major production decision. The current policy is that concurrency will not be used unless there exists exceptional justification.

A development-production gap will cause some additional delay in moving the concept to deployment, but this could easily be outweighed by the considerable potential savings in resources that might result. Some potential benefits of the development/production gap are:

1. It bounds the government risk by preventing the initiation of a costly manufacturing program before all engineering problems are solved and the design is proven.

2. It provides time to learn and evaluate the development results prior to the production start, thus preventing potentially costly mistakes in manufacturing techniques.

3. An improvement in predictability of cost, schedule and performance will result.

4. It allows for incorporation of required changes that surface as a result of the development and operational testing.

5. Wasted effort, such as premature planning, incorrect tooling, improper production line setup, and possible retrofits are avoided,

6. It presents a more conservative face to the Congress who must approve commitment of funds to systems production.

There are also some potential impacts that might negatively affect a program:

1. During a period when there is a high rate of inflation, a long gap would severely escalate the cost of a system.

2. There would be a loss of the learning which was accrued in the development phase.

3. Overhead rates could increase.

4. It could break up the management team approach that is essential to a smooth-running acquisition.

5. The program would be much more vulnerable to budget cuts or cancellation.

What is the net effect of the development production gap and what influence can the program manager have over it? Undertaking production before development is completed greatly increases program risk. It may substantially reduce the time span from concept to deployment but it involves a commitment to incurring substantial costs which may be wasteful in the event of program design modification, cancellation, or redirection. This kind of concurrency is to be avoided and will be approved by the Secretary of Defense only in rare instances. Steps may be taken in the development process that will smooth the transition into the production phase. One example is long lead time materials which may have to be ordered in advance to prevent an unbearable delay in the transition from the full-scale development phase to the production phase.

Program planning in such a case would evaluate the trade-off between probability of delay and waste. Risk assessment is a means of estimating the amount of potential waste, and the probability that the waste will occur. Usually advanced procurement of long lead items represents a relatively small part of the total program budget and is an attractive program alternative.

Successful programs tend to be characterized by a continuity of effort. Initiation of a full production program does not take place until after development is completed but, by deft use of program acquisition strategy and skillful risk management, the spirit of current policies can be accommodated and still avoid a significant program gap between development and production.

1. Release for long lead material or effort which is discussed in Chapter 7 of this handbook

2. Pilot or Low Rate Initial Production (LRIP) and

3. Additional systems for test and evaluation.

LOW RATE INITIAL PRODUCTION

Low rate initial production (LRIP) is a term describing a low rate of output at the beginning of manufacture to reduce the government's exposure to large retrofit programs and costs. LRIP has two major purposes. First, it demonstrates that the production process and techniques are capable of producing the required quality and quantity of output. Second, it may provide production representative items for the completion of development (to include live-fire) and/or operational testing.

If full scale-development or pre-production prototypes are used for both development and initial operational testing in the FSD phase, they must be sufficiently representative of the expected production items to provide a valid estimate of operational effectiveness and suitability. These prototypes and any pilot line/tooling costs under a development contract should be funded by the RDT&E appropriation. Retention of the pilot line capability for LRIP and production is funded with the appropriate procurement account.

Often, the prototypes are handmade (albeit to government specification), then a production line manufacturing process changes the operating characteristics of the item, or it is discovered that the item can not be successfully produced using methods different from the hand-tooled article. These problems lead to significant rework, additional testing, producibility changes, and may cause schedule and cost growth.

To reduce the risks mentioned above, it may be desirable to acquire a limited number of LRIP items to complete IOT&E. However, an operational test assessment is still required prior to LRIP approval. There is still the risk that the additional operational testing may reveal deficiencies resulting in significant changes to the production line or article; however, these problems are mitigated by the ability to correct deficiencies prior to fielding. Tooling and other costs to start LRIP should be borne by the appropriate procurement appropriation. LRIP items to be consumed in IOT&E should be funded by RDT&E. LRIP items to be used in IOT&E, but returned to the operational inventory, should be funded by a procurement appropriation.

For major defense acquisition programs, the OSD Director of Operational Test and Evaluation must provide an operational test assessment to the SECDEF and to the Congress before the Secretary can authorize full rate production. All production line costs for follow-on-test and evaluation (FOT&E) and inventory should be funded from a procurement appropriation.

The major purpose of LRIP is two fold. First, it provides for test completed items which are representative of the production configuration ensuring that the test results will be indicative of the performance which should be expected from production line output. Second, it demonstrates that the production process and techniques which will be used are capable of producing the required quantity and quality of output.

ORGANIZATIONAL ISSUES

At the completion of the development process, a review is normally held at the Service level to determine if the system is ready to enter the production phase of the program. Approval to proceed into the production phase is based upon:

a) Assurance that risks have been resolved, including the threat.

b) Cost, schedule, and performance estimates/requirements for production phase are credible and acceptable.

c) Determination that: a practical engineering design has been completed, tradeoffs have optimized production, maintenance, and operating costs and contractual aspects are sound.

Evaluating the production readiness of a weapon system prior to a production decision point is an important element of the DOD weapon system acquisition process. Production readiness is assessed by means of a

Production Readiness Review (PRR). The objective of a PRR is to verify that the production design, planning and associated preparations for a system have progressed to the point where a production commitment can be made without incurring unacceptable risks of breaching thresholds of schedule, performance, cost, or other established criteria. The Production Readiness Review is discussed in detail in Chapter 12 of this guide.

Producing a system for inventory is the ultimate goal of the weapon system acquisition process and the success of transitioning from development to production is one key to how well this goal will be attained. In terms of resources, the production phase consumes approximately half of the Defense budget and about three times what is spent in the development effort.

The OSD focused attention on minimizing the risks associated with transitioning defense systems from the full-scale development phase to the production phase by the issuance of DOD Directive 5000.34, "Defense Production Management." This document assigned specific production management responsibilities within the OSD and the Services. Among those assigned is the exercise of policy and operational control of the DOD Product Engineering Services Office (DPESO). The DPESO mission includes:

- Providing production management assistance to DOD components.
- Providing independent assessments of producibility and production readiness to major programs.
- Among the responsibilities assigned to the heads of DOD components (that include the Services) and their program managers that relate directly to the transition process are:
- Assuring that consideration is given to the producibility of proposed concepts during the concept demonstration and validation phase.
- Assuring that program funding and schedule for reduction of production risk through production engineering and planning and manufacturing technology activities.
- Conducting production readiness reviews in support of limited production and full production decisions. These reviews may include participation by consultants and other DOD Components and attendance by OSD representatives.
- Employing pilot production lines when necessary to validate production readiness, manufacturing operations and cost, and to provide production articles for test and evaluation.

ENGINEERING RELEASE OF THE PRODUCTION DESIGN

As the development and test effort nears completion, the design function must make the necessary revisions to the design media such as drawings, schematics, and bills of materials. These changes are the result of the outcomes of full and subscale tests, producibility studies and other design changes and refinements. As is discussed in Chapter 6 on Manufacturing Planning and Scheduling, the product design is one of the bases of planning development. In most cases, the firm production design does not exist at the time of transition and, consequently, part of the transition planning involves planning for the design release.

A specific design release plan should be developed through a joint effort of the manufacturing and engineering groups. The plan should provide specific dates for release of the individual design details and the assembly concepts. The actual timing of the release often represents a compromise between the manufacturing need date and the ability of the design function to complete and review the design media. The manufacturing need date for engineering release is based upon the lead time required to tool and make the parts when the part will be used in the assembly sequence. The delay in the design engineering function is a result of the workload peak resulting from the need to complete, review and release the total design. The PMO should evaluate the contractor planning for engineering release to assure that proper set back times have been established and that the release schedule will support the manufacturing planning.

When the design release process is initiated, contractor progress should be tracked by the PMO. Delays in release often result in factory schedule slippages and/or increased cost as additional resources are applied to regain schedule.

IMPACT ON PROGRAM MANAGEMENT

In accomplishing the transition, there is a need to change the basic focus of program management. During design and development, there is a premium placed on direct interaction between designers and the floor manufacturing personnel. As the design test articles are being produced, there is a continuing inflow of design change which must be fed into the fabrication facility. As preliminary test data identify problems, fixes are defined and implemented. The control of shop drawings tends to be somewhat loose, reflecting the primary thrust of this phase which is interactive design. The fabrication effort tends to be focused within the more experienced personnel, often involving the use of highly skilled model shop personnel. Quality requirements are specified via drawings and inspection and test documentation to the production facility.

To achieve success in the production phase, the operating style must change toward complete definition of the fabrication and assembly tasks and the transfer of those tasks to the general factory work force. This results in a need for more detailed work instructions and a closely controlled system for changes to the documents used in the factory, such as drawings and process specifications, to build the quantities required to meet the acquisition objective. Extensive documentation required for production planning (discussed in Chapter 8, Manufacturing Technology) must be based on a stable design, quantity requirements and delivery schedule. The amount and timing of engineering changes must be controlled to minimize disruption to production documentation and planned manufacturing schedules.

There is often a need for the contractor to make basic changes in the manufacturing planning and control systems reflecting a change from small lots of parts with relatively dynamic design, to economical lots with fixed design for quantity production. The measures of effectiveness of the manufacturing function also may change to reflect the efficiencies which would be expected in repetitive production and the balancing of work flow through the facility. The program manager should assure that the contractor has evaluated the planning and control systems used in the factory to determine the need for changes to reflect the difference in the fundamental objectives of development and production. Where change is required, an attainable plan for the system transition should be defined by the contractor.